TITLE OF THE INVENTION

DRUM WASHING MACHINE AND METHOD OF CONTROLLING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Korean Patent Application No. 2003-53156, filed July 31, 2003 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates, in general, to drum washing machines, and, more particularly, to a drum washing machine, and a method of controlling the drum washing machine, which efficiently rinses laundry.

2. Description of the Related Art

[0003] Generally, a drum washing machine is a device that washes laundry using drops of water generated by a rotation of a rotary tub having a drum shape.

[0004] In a conventional drum washing machine, a set amount of water is fed into a water tub, which is a fixed tub, to rinse laundry. The water fed into the water tub gradually fills the water tub, and then flows into a rotary tub. Laundry contained in the rotary tub is soaked with the water. If a level of the water rises to a certain level or more, a rinsing process is executed while the rotary tub is rotated in opposite directions. Therefore, some of the laundry coming into contact with an inner wall of the rotary tub is soaked with the water contained in the rotary tub in advance, and then remaining laundry is soaked with the water as the water gradually disperses.

[0005] Therefore, the conventional drum washing machine is problematic in that it takes a long time for all of the laundry to be soaked with water.

[0006] Further, in the conventional drum washing machine, the part of the laundry coming into contact with the inner wall of the rotary tub is sufficiently soaked with water. However, a center part of the laundry is relatively insufficiently soaked with the water, so that the laundry is not uniformly soaked with water. Consequently, there is a problem in that, if rinsing is performed in this state, the rinsing performance is deteriorated.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an aspect of the present invention to provide a drum washing machine, and a method of controlling the drum washing machine, which allows laundry to be uniformly soaked with water within a short time, and to be rinsed while fed water passes through the laundry, thus improving rinsing performance.

[0008] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

[0009] The above and/or other aspects are achieved by providing a method of controlling a drum washing machine including spin-drying laundry by rotating a rotary tub after a washing and/or rinsing operation, wherein the spin-drying of the laundry includes spraying and feeding water into the rotary tub during a time period wherein the rotary tub is inertially rotated.

[0010] The time period of the spraying and feeding of the water may be shorter than a time required for termination of the inertial rotation of the rotary tub.

[0011] The drum washing machine control method may further include pumping water in the rotary tub to outside of the rotary tub until the inertial rotation of the rotary tub terminates.

[0012] The spin-drying of the laundry may be an intermittent spin-drying operation in which the laundry is intermittently spin-dried after the washing and/or rinsing operation.

[0013] The spraying and feeding of the water may also be executed during a time period wherein a rotation speed of the rotary tub rises.

[0014] The above and/or other aspects may also be achieved by providing a drum washing machine including a rotary tub, a spray feed unit to spray and feed water into the rotary tub, and

a control unit to control the spray feed unit, wherein the control unit controls the spray feed unit to spray and feed water into the rotary tub during a time period wherein the rotary tub is inertially rotated at a time of spin-drying.

[0015] The control unit may control the spray feed unit at a time of intermittent spin-drying in which laundry is intermittently spin-dried after a washing and/or a rinsing operation.

[0016] The control unit may also control the spray feed unit to spray and feed the water during a time period wherein a rotation speed of the rotary tub rises.

[0017] The spray feed unit may include a main water feed pipe to feed water to the drum washing machine, an auxiliary water feed pipe having a first end connected to the main water feed pipe, and a second end disposed at an inlet of the rotary tub, an auxiliary water feed valve mounted at the auxiliary water feed pipe, and a spray nozzle mounted at the second end of the auxiliary water feed pipe.

[0018] The control unit may control the spray feed unit so that a time required for the spraying and feeding of the water is shorter than a time required for termination of the inertial rotation of the rotary tub.

[0019] The drum washing machine may further include a pump to drain water in the rotary tub to outside of the rotary tub.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a perspective view showing an internal structure of a drum washing machine, according to an embodiment of the present invention;

FIG. 2 is a control flowchart of a method of controlling the drum washing machine, according to the embodiment of the present invention shown in FIG. 1;

FIG. 3 is a control flowchart showing an intermittent spin-drying operation performed after a washing operation in the method of FIG. 2;

FIG. 4 is a graph showing a start and a termination of a spray rinsing operation of FIG. 3;

FIG. 5 is a control flowchart showing an intermittent spin-drying operation performed after a rinsing operation in the method of FIG. 2; and

FIG. 6 is a graph showing a start and a termination of a spray rinsing operation of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0022] FIG. 1 is a perspective view showing an internal structure of a drum washing machine, according to an embodiment of the present invention. As shown in FIG. 1, main and auxillary water feed pipes 12 and 13 are mounted to allow water flowing from an external water supply pipe to selectively flow into a water tub 10 or a rotary tub 11.

[0023] The main water feed pipe 12 is connected to the water tub 10. The auxiliary water feed pipe 13, which is branched from the main water feed pipe 12, has one end connected to the main water feed pipe 12, and a remaining end disposed at an inlet of the rotary tub 11. Main and auxiliary water feed valves 14 and 15 are mounted at the main and auxiliary water feed pipes 12 and 13, respectively, so as to allow water to selectively flow into the water tub 10 or the rotary tub 11.

[0024] A detergent container 16 is disposed at a portion of the main water feed pipe 12, between the main water feed valve 14 and the water tub 10, to feed water and detergent together into the water tub 10.

[0025] Further, a spray nozzle 13a is mounted at an end of the auxiliary water feed pipe 13 to spray water into the rotary tub 11. Therefore, the drum washing machine is constructed so that water and detergent are fed together into the water tub 10 through the main water feed pipe 12, and only water is sprayed and fed into the rotary tub 11 through the auxiliary water feed pipe 13.

[0026] Further, the auxiliary water feed pipe 13, the auxiliary water feed valve 15, and the spray nozzle 13a form a spray feed unit.

[0027] The water and the detergent flowing through the main water feed pipe 12 move to a lower portion of the water tub 10. A drain pipe 17 is provided at a bottom of the water tub 10. A drain pump 18 and a drain valve 19 are provided at the drain pipe 17 to pump the water and the detergent contained in the lower portion of the water tub 10.

[0028] Moreover, a reversible motor 20 is coupled to the rotary tub 11, which is rotated in forward and reverse directions by an operation of the motor 20.

[0029] The main water feed valve 14, the auxiliary water feed valve 15, the drain pump 18, the drain valve 19, and the motor 20 are electrically connected to a control unit that performs an entire control operation of the drum washing machine.

[0030] Hereinafter, a method of controlling the drum washing machine of this embodiment of the present invention is described through a detailed operating process of the drum washing machine.

[0031] FIG. 2 is a control flowchart of a method of controlling the drum washing machine, according to the embodiment of the present invention shown in FIG. 1. Referring to FIG. 2, a detergent is fed into the water tub 10 and then a set amount of water is fed into the water tub 10 in operation 100. Thereafter, the motor 20 is rotated in forward and reverse directions to rotate the rotary tub 11 in opposite directions, thus washing laundry in operation 101.

[0032] After the washing operation has been completed, waste water contained in the rotary tub 11 is drained in operation 102.

[0033] Thereafter, the motor 20 rotates the rotary tub 11 at a high rotation speed to remove waste water from the laundry. The rotation speed of the motor 20 is lower than a speed at the time of a final spin-drying for a certain period, thus performing an intermittent spin-drying operation in operation 103. In this case, the auxiliary water feed valve 15 is opened to directly spray and feed clean water into the rotary tub 11 while the rotary tub 11 is rotated by rotational inertia just before the intermittent spin-drying operation terminates. Therefore, while the sprayed clean water passes through an outer part of the laundry from a center part of the laundry, waste remaining on the laundry is removed from the laundry. Consequently, the entire laundry is rinsed clean while being uniformly soaked with the clean water within a short time.

[0034] After the washing operation and the intermittent spin-drying operation are performed, clean water is fed again into the water tub 10 through the main water feed pipe 12 in operation 104. Further, the motor 20 is rotated in forward and reverse directions at a preset rotation speed to rotate the rotary tub 11 in opposite directions, thus performing a rinsing operation in operation 105.

[0035] After the rinsing operation is performed, waste water contained in the rotary tub 11 is drained in operation 106.

[0036] Thereafter, the motor 20 is rotated at a high speed to rotate the rotary tub 11, thus performing an intermittent spin-drying operation in operation 107. At this time, water is sprayed and fed into the rotary tub 11 in a similar manner to the intermittent spin-drying operation performed after the washing operation. In the case of the intermittent spin-drying operation performed after the washing operation, the water spraying and feeding operation is only performed once while the rotary tub 11 is rotated by rotational inertia, just before the intermittent spin-drying operation terminates. But in the case of the intermittent spin-drying operation performed after the rinsing operation, the water spraying and feeding operation is additionally performed during an interval when the rotation speed of the rotary tub 11 rises, along with the water spraying and feeding operation being performed during the interval when the rotary tub 11 is rotated by rotational inertia.

[0037] After the rinsing operation and the intermittent spin-drying operation have terminated, a final spin-drying operation may be immediately performed. Alternatively, although not shown in detail in FIG. 2, the final spin-drying operation may be performed after the water feeding operation 104, the rinsing operation 105, the draining operation 106, and the intermittent spin-drying operation 107 are further performed a predetermined number of times. After the final spin-drying operation has been completed, the above control method terminates.

[0038] FIG. 3 is a control flowchart showing the intermittent spin-drying operation performed after the washing operation in the method of FIG. 2. As shown in FIG. 3, the motor 20 and the drain pump 18 are turned on in operation 110. Thereafter, the rotation speed of the rotary tub 11 gradually rises, so that the rotary tub 11 is rotated at a high speed, and waste water is forced out of the laundry. The waste water forced out of the laundry is compulsorily pumped to a drain-outlet by the drain pump 18 and then drained.

[0039] Further, it is determined whether a preset intermittent spin-drying time has elapsed in operation 111. If the preset intermittent spin-drying time has not elapsed, the control unit continues to perform operation 110.

[0040] However, if the preset intermittent spin-drying time has elapsed, the control unit turns off the motor 20 to stop the rotary tub 11, in response to an intermittent spin-drying termination signal indicating that the intermittent spin-drying time has elapsed, in operation 112. At this time, even though the motor 20 is turned off, the rotary tub 11 continues to rotate by rotational inertia. As time passes, the rotary tub 11 is stopped by a friction.

[0041] While the rotary tub 11 is rotated by rotational inertia, the auxiliary water feed valve 15 is turned on in operation 113. Accordingly, water flowing from the water supply pipe passes through the auxiliary water feed pipe 13 and is directly sprayed on the laundry contained in the rotary tub 11 from the spray nozzle 13a. Therefore, as described above, the water removes the waste water from the laundry by rinsing the laundry while passing through the laundry, and is then drained. Thereafter, it is determined whether the auxiliary water feed valve 15 is turned on for a predetermined period in operation 114. For example, a period for which the auxiliary water feed valve 15 is turned on to spray and feed water may be approximately 20 seconds.

[0042] If the turn-on time of the auxiliary water feed valve 15 exceeds the predetermined period (for example, 20 seconds) in operation 114, the auxiliary water feed valve 15 is turned off in operation 115 to stop the above spray rinsing operation.

[0043] Further, it is determined whether a time required for termination of the inertial rotation of the rotary tub 11 has elapsed in operation 116. If the time required for the termination of the inertial rotation of the rotary tub 11 has elapsed, the drain pump 18 is turned off to terminate the intermittent spin-drying operation and then the control unit executes a next control routine.

[0044] FIG. 4 is a graph showing a start and a termination of the spray rinsing operation of FIG. 3. As shown in FIG. 4, when performing the intermittent spin-drying operation after the washing operation, the rotary tub 11 is rotated at a high speed. Further, the water spraying and feeding operation is performed for a certain period just before the intermittent spin-drying operation terminates after the motor 20 is turned off. For reference, during an interval when the rotation speed of the rotary tub 11 gradually rises, the water spraying and feeding operation is not performed. This is due to the fact that, if cool water is sprayed and fed on the laundry while

the laundry contains hot water therein due to heating type washing, soil in the laundry is not sufficiently removed.

[0045] FIG. 5 is a control flowchart showing the intermittent spin-drying operation performed after the rinsing operation in the method of FIG. 2. FIG. 6 is a graph showing a start and a termination of a spray rinsing operation of FIG. 5.

[0046] Referring to FIG. 5, with FIG. 6 taken into consideration, a second control operation of spraying and feeding water while the rotary tub 11 is inertially rotated just before the intermittent spin-drying operation terminates, that is, after the motor 10 is turned off, is the same as that of FIG. 3. However, in the case of the intermittent spin-drying operation performed after the rinsing operation, the water spraying and feeding operation is also performed during an interval when the rotation speed of the rotary tub 11 gradually rises (100 to 400 rpm). That is, when the rotation speed of the motor 20 reaches a preset speed, the auxiliary water feed valve 15 is opened to spray and feed water, thus improving the rinsing performance.

[0047] As is apparent from the above description, the present invention provides a drum washing machine, and a method of controlling the drum washing machine, which directly sprays and feeds water into a rotary tub just before termination of an intermittent spin-drying operation which is performed after a washing or rinsing operation, thus enabling laundry to be uniformly soaked with the water within a short time and improving rinsing performance.

[0048] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.